TITLE

CONTROL ROD SUSPENSION WITH OUTBOARD SHOCK

BACKGROUND OF THE INVENTION

Known shock absorber installations have a similar motion ratio for both roll and vertical wheel movements. Typically, these installations include at least one shock absorber having one end attached to the chassis of the vehicle and the other end attached to the axle of the vehicle.

Examples of known shock absorber installations can be found in, for example, U.S. Patent No. 2,941,817 which provides for a vehicle axle and air suspension assembly. A first end of a shock absorber is attached to an inside portion of a chassis. The second end of the shock absorber is attached to an inside portion of a non-steerable axle.

U.S. Patent No. 4,262,929 teaches a vehicle suspension for connecting an axle to the frame. The suspension includes both a spring and a shock absorber. The upper end of the shock absorber is mounted to a vehicle frame beam. The lower end of the shock absorber is mounted to the axle.

U.S. Patent No. 4,802,690 provides for a suspension assembly for a steering axle. The assembly uses a shock absorber attached to both the chassis side rail and a portion of the axle adjacent the air spring.

U.S. Patent No. 6,073,946 teaches a suspension system for a steerable axle assembly. The system has a shock absorber attached at a first end to the frame of the vehicle and a second end to a plate. The plate is attached to the axle of the vehicle.

U.S. Patent No. 6,135,470 provides for a wheel axle suspension system having a shock absorber. The shock absorber is attached to the chassis frame member and to an axle seat directly above the axle.

The transient roll dampening characteristics of these known installations need to be improved while not exhibiting overly harsh vertical wheel movements. It has been found in the present invention that by locating at least one dampening structure having an inboard end pivotally mounted to a vehicle frame and an outboard end pivotally mounted to a king pin, that the transient roll dampening characteristics are improved.

SUMMARY OF THE INVENTION

This invention fulfills the above-described needs in the art by providing a control rod suspension with at least one dampening structure having an outboard end and an inboard end. The inboard end is pivotally mounted to the vehicle frame. The outboard end is pivotally mounted to a king pin. A king pin rotatably connects the knuckle with a beam axle. The dampening structure improves the transient roll dampening characteristics of the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

The above, as well as other advantages of the present invention, will become readily apparent to those skilled in the art from the following detailed description when considered in the light of the accompanying drawings in which:

Fig. 1 is a sectional, perspective view of a construction embodying the present invention;

Fig. 2 is a side view of a portion of the invention depicted in Fig. 1;

Fig. 3 is a side view of a portion of the invention depicted in Fig. 1;

Fig. 4 is a top view of yet another construction embodying the present invention;

Fig. 5 is a side view of the construction depicted in Fig. 4; and

Fig. 6 is a side view of yet another construction embodying the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It is to be understood that the invention may assume various alternative orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions, directions or other physical characteristics relating to the embodiments disclosed are not to be considered as limiting, unless the claims expressly state otherwise.

Fig. 1 of the present invention depicts two substantially parallel chassis frame rails 10. The chassis frame rails 10 may be such as, for example, from a Peterbilt ® 377 chassis made by Peterbilt Motors Company of Denton, Texas, although those skilled in the art will understand that other chassis frame rails 10 may be used without departing from the scope or spirit of the invention. A steer axle beam 12 is preferably located beneath the chassis frame rails 10. In a preferred embodiment, the steer axle beam 12 is a front steer axle beam 12 such as for example a Dana ® Spicer ® Steer Axle from the E-1200 W series made by Dana Corporation of Toledo, Ohio, however, the present invention can be used with any axle system. The steer axle beam 12 is connected to the

chassis frame rails 10 through devices and methods known by those skilled in the art. One such connecting device is at least one air spring 14. The air spring 14 may be such as a Firestone IT14F-4 air spring made by Bridgestone Americas Holding, Inc. of Nashville, Tennessee, however, other air springs may also be used.

The front axle beam 12 has a first end portion 16 and a second end portion 18. Both the first 16 and the second end portions 18 are located outboard from the chassis frame rails 10. End portion 16 has a first 20 cylindrical portion integrally formed therewith. End portion 18 has a second 22 cylindrical portion integrally formed therewith.

A first 24 and a second knuckle 26 are each rotatably mounted to the first 20 and second 22 cylindrical portions, respectively, of the front steer axle beam 12. Preferably, the first knuckle 24 is mounted by locating a first king pin 28 through both the knuckle 24 and the first 20 cylindrical portion of the front steer beam axle. A second king pin 30 similarly mounts the second knuckle 26 to the second 22 cylindrical portion of the front steer axle beam. The knuckles 24, 26 may be such as for example a Dana ® Spicer ® steer knuckle from the E-1200 W series made by Dana Corporation of Toledo, Ohio, however, the present invention can be used with any knuckle.

The following description, for clarity, will describe the remaining portions of the suspension with reference to a first side 32 of the suspension. Unless specified otherwise, a substantially identical complimentary structure is present on a second side 34 of the suspension.

Additionally, this description and the accompanying figures depict a Watts link type suspension 36. It should be understood, however, that the present invention can be

used with many types of suspensions including, by way of example only and without limitation, an link air leaf suspension, a trailing arm suspension and a parallelogram rod suspension.

As best seen in Fig. 2, an upper king pin bracket 38 is located adjacent an upper portion 40 of the knuckle 24. A top portion 42 of the king pin 28 extends upwardly from the knuckle 24 through an aperture 44 in the bracket 38. The top portion 42 of the king pin 28 preferably has a threaded surface 46 for receiving a complimentary threaded nut 48. The nut 48 is located on the king pin 28 and tightened thus connecting the bracket 38 to the king pin 28.

In a preferred embodiment depicted in Figs. 1 and 2, the upper king pin bracket 38 has an attachment portion 50 for a dampening structure 52 and an attachment portion 54 for a rear suspension linkage 56.

A lower king pin bracket 58 is located adjacent a lower portion 60 of the knuckle 24 in a manner similar to that described for the upper king pin bracket 38. The lower king pin bracket 58 preferably has an attachment portion 62 for a front suspension linkage 64 and an attachment portion 66 for a steering tie rod 68.

A knuckle steer arm 70 is preferably located below the upper king pin bracket 38 and above the steer axle beam 12. Additionally, the knuckle 24 extends in an outboard direction and has a knuckle spindle 72 for receiving a vehicle wheel (not shown), as known by those skilled in the art.

Still referring now to Figs. 1 and 2, at least one dampening structure 52 is attached to the chassis frame rail 10 and the dampening structure attachment portion 50 of the upper king pin bracket 38. An inboard end 74 of the dampening structure 52 is

preferably pivotally mounted to the chassis frame rail 10 with at least one bracket 38. Similarly, an outboard end 78 of the dampening structure 52 is preferably pivotally mounted to the dampening structure attachment portion 50 of the upper king pin bracket 76. Both the inboard 74 and outboard 78 ends of the dampening structure 52 are attached to their respective attachment points by any structure which allow the two to pivotally move with respect to one another, such as a pin 80.

The dampening structure 52 may be any device that mechanically connects the chassis and an end portion, 16 or 18, and that dampens a compressive and/or de-compressive force between the chassis and an end portion 16 or 18.

In a preferred embodiment, the dampening structure 52 is a shock absorber as known to those skilled in the art. The shock absorber may be for example, a Monroe Shock absorber manufactured by Tenneco Automotive Company of Monroe, Michigan. Those skilled in the art understand that any type of shock absorber may be used depending upon the desired ride and desired vehicle dynamic roll rate. Additionally, those skilled in the art will appreciate that any viscoelastic member and/or any mechanical member such as, without limitation, air shocks/bags and/or struts and/or shocks and/or springs, can be used as the dampening structure.

Preferably, the dampening structure 52 is angled so that a longitudinal centerline 82 of the dampening structure 52 is at an acute angle 84 (i.e., less than ninety degrees) from the vertical 86, as depicted in Fig. 3. In the present embodiment, the vertical 86 is perpendicular to the plane of the supporting surface on which the present invention resides. The exact angle is dependent upon the desired response of the dampening structure 52 to both vertical and roll movements and the stiffness of the dampening

structure 52 selected. Thus, for a dampening structure 52 of a given stiffness, mounting the dampening structure 52 at a relatively low angle, such as between zero and approximately twenty degrees, will result in high roll dampening, but reduced vertical dampening. Similarly, mounting that same dampening structure at a relatively high angle, such as between approximately sixty and ninety degrees, will result in high vertical dampening, but reduced roll dampening. Thus, it is preferred that the dampening structure 52 be at an approximate angle of twenty to sixty degrees to have desirable vertical and roll dampening characteristics, although other angles are well within the scope of the present invention.

In a preferred embodiment, the selected angle maximizes the perpendicular distance 88 from the centerline 82 of the dampening structure 52 to a vehicle suspension roll center point 90. The vehicle suspension roll center point 90 is the point about which the vehicle chassis rotates in response to a roll input. The suspension roll center point 90 is alternately defined as the point in the transverse axle plane at which lateral forces may be applied to the chassis without producing suspension roll. Maximizing this distance reduces the vehicle dynamic roll and provides shock absorption in the vertical direction. It is also well within the scope of the present invention to connect the dampening structure 52 to the chassis rail 10 and the portion of the beam axle 16 without concern for maximizing the distance to provide a degree of vehicle dynamic roll reduction and shock absorption.

In a preferred embodiment, a dampening structure 52 having what is characterized by those skilled in the art as a high dampening coefficient is used. The acute installation angle 84 of the dampening structure 52 reduces the effectiveness of the dampening

structure 52 in vertical motion, however, the installation angle allows the dampening structure 52 to be effective in roll. Other dampening structures 52, such as for example, air springs can be used to supplement the effectiveness of the suspension in the vertical direction.

In an alternative embodiment depicted in Figs. 4 and 5, each of the above described components can be seen in addition to a torsion tube 92. The torsion tube 92 resists, or prevents, twisting of the steer axle beam 12 during roll.

A bracket 94, having an aperture 96 for the torsion tube 92, is attached to a steer beam axle spring pad 98. The bracket 94 may be located anywhere on the steer axle beam 12. In a preferred embodiment, the bracket 94 is located under an air spring 14. The aperture 96 accommodates the torsion tube 92 which extends from one end of the steer axle beam 12 to the other end of the steer axle beam 12 where it is received by a substantially identical bracket (not shown).

In yet another embodiment of the present invention depicted in Fig. 6, a suspension, substantially identical to that disclosed above is depicted. The front suspension linkage 100 and the rear suspension linkage 102, however, are attached to a suspension bracket 104. Preferably, the suspension bracket 104 is of a one-piece construction, however, the bracket 104 may be of a multi-piece construction without departing from the scope of the invention. The suspension bracket 104 connects both linkages 100, 102 to the steer axle beam 12 and forms the lower seat 106 for an air spring 12. Preferably, the suspension bracket 104 is attached directly to the steer axle beam 12.

In accordance with the provisions of the patent statutes, the present invention has been described in what is considered to represent its preferred embodiments. However, it

should be noted that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.